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Impact of Salt Stress on Germination and Growth on Chickpea (*Cicer arietinum* L.): A Review

Deva Jyotsna*, Ankhisatpathi, Om Swaroop, Navdeep Singh and C. Dinesh Kumar

School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

**Corresponding author*

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A B S T R A C T

Chickpea (*Cicer arietinum* L.) is among those major pulse crop which is majorly grown along the semi-arid and arid regions across the world, most often on saline soils chickpea is highly sensitive to salinity and its growth is highly affected. The main aim of this study was to examine the affect on germination and early stages of growth in chickpea by different salt concentrations in solutions. So that to determine the safe degree of salinity that can be used for the crop cultivation. Salinized artificially rooting media with sodium chloride has been used to study the salt tolerance level in chickpea varieties C-44 and Pb-91. Thus, results stated that with increase in salinity level, there was gradual decline in seedling characters, germination, yield and yield components.

Introduction

Chickpea (*Cicer arietinum* L.), which is also known as Bengal gram or Garbanzo bean, is an Old-World pulse crop, and in the Fertile Crescent of the Near East, it was one of seven Neolithic founder crops (Lev-Yadun, Gopher & Appo (2000)). Chickpea offers excellent grade protein, increases the input of combined N2 in soil and is most prominent crop of the Mediterranean region (Herridge *et al.*, 1995). Among all the food legumes for world production, chickpea holds third position (FAO 2008) after beans (*Phaseolus* spp.) and field pea (*Pisum sativum* L.). The two different varieties of chickpea used for cultivation are: Kabuli (macrosperma) and Desi (microsperma). Desi type of chickpea variety posses pink flowers, coloured and thick seed coat, and ananthocyanin pigmentation on stems. Whereas The Kabuli type of chickpea possess white flowers, seeds with white or beige colour, seed shape like a ram's head, seed coat is thin and consists a smooth surface and it lacks anthocyanin pigmentation on stems (Moreno and Cubero (1978).

140 kg N ha-1 year-1 is fixed by chickpea and has a key role in sustaining soil fertility. it also has great value in human food as well as animal feed (Rupela, 1987). Thus, this crop

requires very low-input, and 70% of its nitrogen demand is derived by symbiotic N2 fixation and other cereal crops are benefited (Siddique *et al.*, 2005). The major stress factors of this crop is salinity that leads to limitation in production of crop caused by osmotic and specific ion effects in most of the semi-arid as well as arid regions across the world (Bernstein, 1975).In many regions of the world Salinity of soil is one of the major factor of environmental constraints in agriculture. Salt stress majorly affects the growth and symbiotic performance of nodulated legumes (Boyer, 1982; Serrano and Gaxiola, 1994). Especially at reproductive stage of growth chickpea is highly susceptible to salt stress (Kotula *et al.*, 2015), first the roots of crop suffers (Tejera *et al.*, 2006) which further results in lesser productivity (Singla and Garg, 2005; Sohrabi *et al.*, 2008). Germination and early stages of chickpea are mainly affected by soil salinity (Khan *et al.*, 2013).

Effect of salt stress on plant growth

Increased level of concentration of NaCl in soil possesses an unfavourable effect on length of plumule and radical which leads to suppress growth of radical and plumule. The growth medium when contain any unexpected salt concentration can lead to reduction of absorption of water due to osmotic potential lessening and affect cell division (Ashraf and Harris, 2005). Negative effect in the length of plumule and radical is seen in this salt experiment. As per, (Kausar et al., 2012) salinity effect retards the length of plumule and radical and other affects are may be due to disruption in uptake of nutrients, ion toxicity (Akhter *et al.,* 2012), osmotic effects of salinity (Ashraf and Harris, 2005), water absorption (Ashraf and Sarwar, 2002), which results in reduction of plant hormones required for growth and biosynthesis of enzymes (Bor et al., 2003). As NaCl concentration level is increased, the length of radicle and plumule are decreased in all land races. These results are stated in many researches (Farsiani and Ghobadi, 2009; Jajarmi, 2009).

Germination

At high Salinity levels the germination results were suppressed whereas good germination was seen in control and other salinity levels. Gram variety Pb-91 indicated high percentage of germination when compared with C-44 variety. With increase in salinity level, germination percentage was decreased (Mrumaker and Chavan, 1987).

Seedling growth

All salinity levels suppressed the length of plumule and radical when compared with control. At lower salinity level, fresh weight of seedling was observed same as in control. Both Pb-91 and C-44 varieties resulted decrease in fresh weight of seedlings (Hanks *et al.*, 1977). Similarly when salinity levels were increased beyond extreme had no affect on fresh weight of seedling. Salinity level when compared to control has majorly affected dry weight of seedling. When compared high saline medium to control, it showed gradual decrease in seedling’s dry weight (Dua and Sharma, 1995). In control and low salinity levels, the growth of radical and plumule lengths and dry and fresh weights were observed finest, while at high saline treatments the growth resulted poor in both the varieties. Intermediate growth of seedlings was observed in moderately saline treatments. Accretion of toxic ions in radical and plumule seedlings and reduction of water availability physiologically with increased suction of solute from salt medium leads to decline seedling’s fresh weight (Gill and Dutt, 1983).

Plant growth and yield

Pb-91 gram variety possessed longer shoot and root length than that of C-44. In high saline treatments the root length was short and the longest root length was observed in control. The dry weight of shoot was progressively decreased with increase in the levels of salinity. The total yield produced was more by Pb-91 variety and the lesser total yield was produced by C-44 variety.

The count of flowers per plant is reduced and delay in flowering was observed in these varieties with increase in salinity levels (Datta *et al.,* 1981; Dhingra and Varghese, 1993). Total yield of these varieties gradually decreased due to salinity (Manchandra and Sharma, 1990). Adverse effects were seen on both the varieties but C-44 showed more reduction than Pb-91. Thus, both these varieties resulted to be salt sensitive. But when compared with Pb-91, C-44 was more salt sensitive based on their growth parameter.

Nitrogen fixation

Adverse effect of salinity on N2 fixation in plant legumes, reduced the supply of photosynthate to nodules (Bekki *et al.,* 1987; Georgiev and Atkins, 1993). Oxygen-diffusion barrier alteration (Serraj *et al.,* 1994) and reduction of respiratory substrate supply to the bacteroids (Delgado et al.1993, 1994) have been explained by advancement of several hypothesis.

The bacterial symbiosis with chickpea roots was suppressed in presence of salinity in the soil. Salinity of soil also leads to decrease the regulation of biological procedure in improvement of crop growth (Zurayk *et al.,* 2008). The harmful effects on nodule initiation by salinity lead to reduction in formation of nodules by the sensitive cultivars. Invigoration in nodule count and dry mass of nodule due to salinity vary from the records of (Elshiekh and Wood (1990), Sheokand *et al.,* (1995) and decrease in nodulation under salt stress was observed by most of the other workers. But, current records estimated by Soussi *et al.,* (1999) and Cordovilla *et al.,* (1999) have indicated a gush in growth of nodule that gradually increased the nodule's dry mass.

Physiological changes in growth of chickpea

Chickpea raised in NaCl (100mm) resulted in decrease in concentration of photosynthetic pigments (Datta and Sharma 1990; Beltagi 2008), therefore 60% reduction in photosynthesis was resulted (Murumkar and Chavan 1993). Due to the effect on chlorophyll-fluorescence by salinity, genotypes have also shown to differ (Epitalawage et al., 2003). Senescence in chickpea is increased due to salinity (Katerji *et al.,* 2001) and leads to induction of ethylene production in root nodules (Kukreja *et al.,* 2005; Nandwal *et al.,* 2007).

In conclusion thus, germination as well as early stages of growth are highly effected by salinity in soil. Germination stage is very highly susceptible to salinity. Chickpea can be cultivated in marginally saline environment (0.61 ± 0.04 g/L range of NaCl concentration), without any considerable decrease on its growth and development. When the crop is exposed to higher degrees of salinity it results in strong suppression.

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